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A Formal Estimation of the Effect of the MFA on Clothing Exports from LDCs

Junichi Goto

Exporting developing countries are losing a lot under the MFA's restrictions on trade in clothing: the trade-suppressing effects on restricted suppliers are big; the spillover effects on unrestricted LDCs are small.

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This paper — a product of the International Trade Division, International Economics Department — is part of a larger effort in PRE to assist developed and developing countries evaluate the effects of tariffs and nontariff barriers on international trade. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Maria Teresa Sanchez, room S8-040, extension 33731 (32 pages with figures and tables).

This paper establishes a simple general equilibrium trade model to estimate the effects of the Multifibre Arrangement (MFA) on world trade in clothing, especially on exports from developing countries.

The MFA, in effect for more than a quarter of century, has strongly influenced world trade in textiles and clothing. Although intensive negotiations on the abolition of the MFA are under way in the Uruguay Round, there is little hope for its imminent demise.

The MFA greatly affects developing countries because the MFA restrictions are imposed discriminatively on the exports from developing countries. Until very recently, however, the emphasis of empirical studies of the MFA was on importing developed countries rather than exporting developing countries.

One of the main features of the estimation in this paper is its recognition of the underuse of MFA quotas. Contrary to popular belief, the MFA quotas are sometimes not binding because the use of the quotas is very low.

Although the structure of the model is simple (two markets and six groups of suppliers), it is useful for analyzing various effects of the MFA, including:

- The trade-suppressing effect (how much the clothing exports from restricted LDCs are suppressed due to the MFA).

- The trade-diversion effect among markets (how much the clothing imports are increased when one of the markets, either the United States or the European Community, unilaterally lifts the MFA restrictions).

- The spillover effect (how much unrestricted LDCs benefit from the restrictions on other LDCs).

Domestic producers in the developed countries, especially those in the United States, have benefited greatly from the MFA restrictions. The value of shipments of clothing by U.S. producers is more than $3 billion higher ($400 million for EC producers) than they would have been otherwise. When MFA quotas and tariffs are taken together, the value of clothing shipments by U.S. producers is $8 billion higher ($1.5 billion for the EC producers) than without such restrictions.

The spillover to unrestricted developing countries (such as most Latin American countries) is much smaller than often alleged. The spillover effect to unrestricted LDCs is less than $200 million (or a mere 2 percent of the value of shipments by the unrestricted LDCs).

But the trade-suppressing effect on the restricted LDCs (such as Hong Kong and South Korea) is much larger than that of spillover. Due to the MFA, the value of the clothing exports from restricted LDCs is suppressed by more than $1 billion, even in the short run. In the long run, after various adjustments, the lost shipments of LDCs restricted by the MFA amount to more than $2 billion.

A Formal Estimation of the Effect of the MFA on Clothing Exports from LDCs

by
Junichi Goto*

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I. INTRODUCTION

The purpose of this paper is to establish a simple general equilibrium trade model, and to estimate the effects of the Multifibre Arrangement (MFA) on world clothing trade, especially on exports from developing countries.

The MFA has been in effect for more than a quarter of century, and, as I summarized elsewhere (Goto (1989)), it has strongly influenced world trade of textiles and clothing. Although intensive negotiations are being made on the future abolition of the MFA under the Uruguay Round, there seems little hope for its imminent demise. Since the MFA have existed for so many years, both importers and exporters of textile and clothing products have been greatly affected, and various attempts have been made to estimate the magnitude of the effects of the MFA on developed and developing countries. Obviously, the MFA strongly affects developing countries because the MFA restrictions are discriminatively imposed on the exports from LDCs. Until very recently, however, the emphasis of the empirical studies of the MFA was placed on the effects on importing developed countries rather than the effects on exporting developing countries.

Trela and Whalley (1988) estimated the welfare cost of the MFA to developing countries by using a rigorous general equilibrium framework. They showed, among others, that if the MFA were removed, the developing countries as a whole would gain by more than 3 billion dollars. Although their framework is pathbreaking, there exists wide room for improvements. For example, they assumed that every MFA quota is binding. But, as is shown later in this paper, in many cases the MFA quotas are not fully utilized, and the quota utilization rate is

sometimes as low as 10-20 percent. The estimation result would be misleading if such underutilized quotas are assumed to be binding.

In some sense, the present paper is an extension or complement of Trela-Whalley paper. Although both papers present estimation based on rigorous general equilibrium framework, there are some differences between the two. The major difference includes: (i) the present paper incorporates in the model the additional realities like underutilization of quotas; (ii) the emphasis of the present paper is placed on effects on trade (especially exports from the LDCs) while in Trela-Whalley it is on the effect on welfare; (iii) the model developed in the present paper is much simpler than that in Trela-Whalley; (iv) product differentiation is more emphasized in the present paper.

In what follows, the outline of the model will be presented first, and in the following section the data and detailed estimation method will be discussed. After those, it will be estimated by using the model how the world trade pattern of clothing (especially clothing exports from the LDCs) would be affected if the MFA and/or tariffs were removed.

II. THE MODEL

1. Overview

Before presenting a rigorous mathematical formulation, it would be useful to summarize the outline of the model. First of all, in the model, it is assumed that there are two markets of clothing: the U.S. market and the EC market. Although there are many other countries which import clothing, e.g. Japan, non-EC European countries, developing countries etc., the United States and the European Community are the two most important markets and they import major part of the world clothing. As Table 1 shows, the combined share of the

U.S. market and the EC market in the world imports of clothing is more than 70 percent. In view of the dominance of the U.S. and the EC, I assume, for simplicity, that there are only two markets, the U.S. and the EC, of the clothing trade.

Table 1: SHARE OF SELECTED IMPORTERS IN WORLD CLOTHING TRADE

	1985	1986	1987	1988
TOTAL	100.0	100.0	100.0	100.0
U.S.A.	34.1	30.9	28.4	27.9
EC	36.8	41.9	43.5	43.8
JAPAN	4.2	4.8	6.0	8.2
LDC	8.7	[illegible].4	6.5	6.7
Other	16.1	[illegible].0	15.7	13.4

Source: United Nations Trade Statistics.

Table 2: CLOTHING IMPORTS BY SOURCE

Source	USA		EC	
	Value ($million)	Share (%)	Value ($million)	Share (%)
Total	18,692	100.0	13,308	100.0
USA	-	-	149	1.1
EC	1,640	8.8	-	-
LDC	16,246	86.9	12,558	94.4
Other	806	4.3	601	4.5

Note: *Excluding intra-EC trade

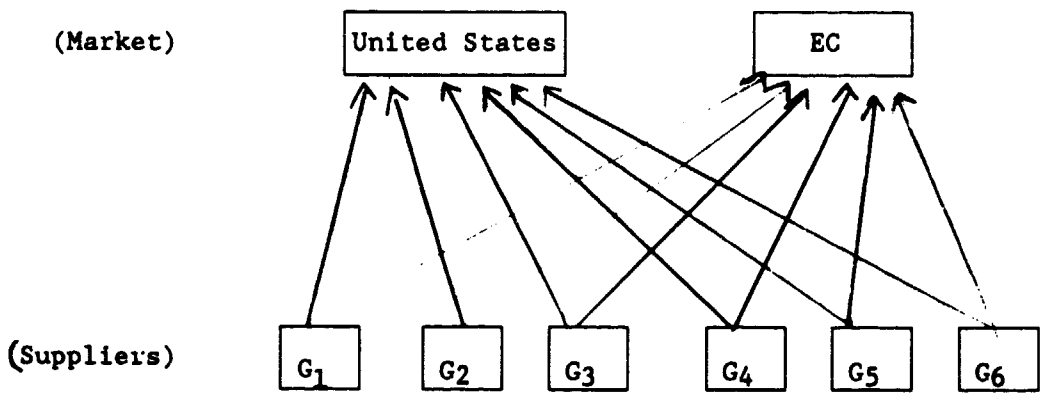
Source: United Nations Trade Statistics

Secondly, both markets are assumed to be supplied by the U.S. producers, the EC producers, and LDC producers. Again, there are other producers in the world, such as Japanese producers and Swedish producers. But, as shown in Table 2, in the U.S. market and the EC market, almost all (more than 95 percent) clothing are supplied by the above three categories of suppliers. Therefore, it seems reasonable to disregard in the model other suppliers whose combined share is less than 5 percent in either market.

Thirdly, the LDC suppliers are further classified according to the existence of binding quotas in the two markets: (i) LDCs which are restricted by the binding quotas of both the U.S. and the EC; (ii) LDCs which are restricted by the binding quotas of the U.S. but not of the EC; (iii) LDC which are restricted by the binding quotas of the EC but not of the U.S.; and (iv) LDC which are not restricted by the binding quotas.

Figure 1 shows a diagrammatic expression of the basic framework of the model.

Figure 1: FRAMEWORK OF THE MODEL



Note: G_1 = the United States
G_2 = the EC
G_3 = LDCs restricted by the binding quotas in the two markets.
G_4 = LDCs restricted by the binding quotas in the US but not in the EC.
G_5 = LDCs restricted by the binding quotas in the EC but not in the US.
G_6 = Unrestricted LDCs.

2. Demand Functions

Clothing products from different (groups of) countries are assumed to be differentiated products. This formulation is well known as Armington assumption. Since each product is an imperfect substitute from other products, the quantity demanded of the product is affected not only by its own price but also by the prices of other products. Since we have 6 categories of products, we have 12 demand functions (6 in each market) in the model. In order to simplify the mathematical formulation, the demand functions are given by linear functions as follows:

<U.S. MARKET>

$$(1) \quad QD_i^{US} = a_{i,o} + \sum_{j=1}^{6} a_{i,j} PD_j^{US}, \quad (i = 1, 2 \ldots, 6)$$

<EC MARKET>

$$(2) \quad QD_i^{EC} = b_{i,o} + \sum_{j=1}^{6} b_{i,j} PD_j^{EC}, \quad (i = 1, 2 \ldots, 6)$$

where QD_i and PD_i are quantity of demand for product i (i.e. product of supplying country group i) and tariff-inclusive demand price of product i, respectively. Superscripts (US or EC) denote the market. Note that, since we have 6 groups of suppliers in the model, equations (1) and (2) determine twelve demand functions.

3. Supply Functions

As mentioned above, we have 6 categories of suppliers. The supply function of each supplier is characterized as follows:

$$(3) \quad QS_i = c_i + d_i PS_i, \quad (i = 1, 2 \ldots, 6)$$

where QS_i and PS_i are the supply quantity of product i and supply price (exclusive of tariff and quota premium) of product i, respectively. In order to keep the simplicity of the model, the supply functions are also given in linear form. Although the basic formulation of the model is thus simple, as will be discussed later, it turns out to be so powerful that it serves for the analysis of various effects of the MFA, including trade diversion toward unrestricted market and so-called spillover to the unrestricted developing countries.

4. Equilibrium under the MFA quotas and tariffs

Once we characterize the demand and supply behavior, it is very easy to derive equilibrium conditions of the model. First of all, since the quantity demanded must be equal with quantity supplied in equilibrium, the equation (4) holds in all equilibria (e.g. quota equilibrium, free trade equilibrium). Note that equation (4) represents six equilibrium conditions because we have six groups of suppliers.

$$(4) \quad QD_i^{US} + QD_i^{EC} = QS_i, \quad (i = 1, 2 \ldots, 6)$$

In other words, in equilibrium, the quantity supplied by each group must be equal to the sum of demands for the product in the U.S. market and the EC market.

Since we are ignoring transportation cost in the model, demand prices (PD_i) are equal with supply prices (PS_i) in free trade equilibrium. But, when tariffs and/or quotas exist, the demand prices are higher than the supply prices by the tariff rate and/or by the quota markup. In this paper, subscript i in PD_i, PS_i, QD_i, QS_i stands for the price or quantity of the product supplied by the producer in country group G_i in Figure 1 above. Therefore, following conditions hold between the demand prices and supply prices in the equilibrium with the MFA quotas and tariffs.

<US MARKET>

$$(5) \quad PD_1^{US} = PS_1$$

$$(6) \quad PD_2^{US} = (1+t^{US})\, PS_2$$

$$(7) \quad PD_3^{US} = (1+t^{US})(1+m^{US})\, PS_3$$

$$(8) \quad PD_4^{US} = (1+t^{US})(1+m^{US})\, PS_4$$

$$(9) \quad PD_5^{US} = (1+t^{US})\, PS_5$$

$$(10) \quad PD_6^{US} = (1+t^{US})\, PS_6$$

<EC MARKET>

$$(11) \quad PD_1^{EC} = (1+t^{EC})\, PS_1$$

$$(12) \quad PD_2^{EC} = PS_2$$

$$(13) \quad PD_3^{EC} = (1+t^{EC})(1+m^{EC})\, PS_3$$

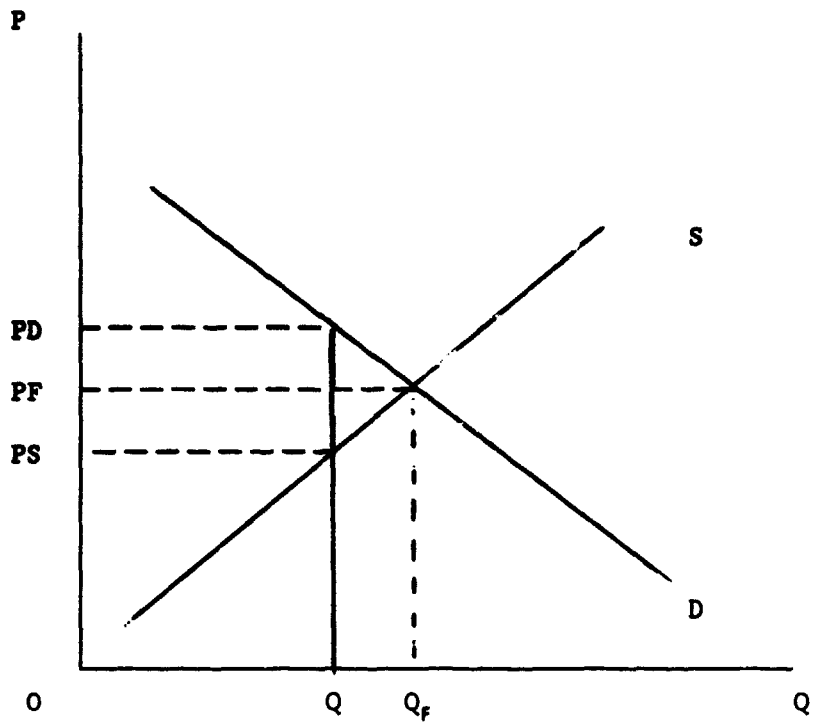
$$(14) \quad PD_4^{EC} = (1+t^{EC})\, PS_4$$

$$(15) \quad PD_5^{EC} = (1+t^{EC})(1+m^{EC})$$

$$(16) \quad PD_6^{EC} = (1+t^{EC})\, PS_6$$

where t^{US} and t^{EC} are tariff rate imposed on clothing in the United States and in the EC, respectively, and m^{US} and m^{EC} are price markups due to the MFA quotas in the U.S. and in the EC, respectively. For example, Figure 2 represents such a price gap when quotas are in effect. Namely, when the amount of imports is restricted at Q (less than the amount of imports under no quota), the demand price (PD) is higher than the supply price (PS). As explained in detail below, m's (the degree of price markup) are considered to be endogenous variables in the (theoretical) model because they are influenced by the quota level, but in the actual estimation I used the previously estimated values of m's and therefore I treat m's as being exogenous.

Figure 2: AN EQUILIBRIUM UNDER QUOTA



As mentioned earlier, (see Figure 1) G_1 is the United States, and the demand price of its product in the EC market is higher than the supply price by the tariff rate of the EC while in the U.S. market the demand price is the same as the supply price. G_2 is the EC, and the demand price of its product in the U.S. market is higher than the supply price by the tariff rate of the United States while in the EC market the demand price is the same as the supply price. G_3 is the group of the LDCs which are restricted by the binding quotas both in the U.S. market and in the EC markets, and its demand prices in the both markets are higher by the tariff rate and by the price markup due to the MFA quotas. G_4 is the group of the LDCs which are restricted in the U.S. market alone, and therefore the demand price of its product in the U.S. market is higher than its

supply price by the U.S. tariff rate and by the quota markup while in the EC market the difference is only by the EC tariff rate. G_5 is the group of the LDCs which are restricted in the EC market alone, and therefore the demand price of its product in the EC market is higher than its supply price by the EC tariff rate and quota premium while in the U.S. market the difference between the demand price and supply price is only by the U.S. tariff rate. G_6 is the group of the LDCs which are not restricted by the binding quotas in either market, and the demand prices in each market is higher than the supply price only by the tariff rate.

The above system of equations (equation (1) through equation (16)) completes the model. By using the above equilibrium conditions, the model can be solved for the following 34 endogenous variables. In the equilibrium under the MFA quota, the endogenous variables in the model are as follows:

(quantity demanded) QD_1^{US}, QD_2^{US}, QD_5^{US}, QD_6^{US}, QD_1^{EC}, QD_2^{EC}, QD_4^{EC}, QD_6^{EC}

(quantity supplied) QS_1, QS_2, QS_3, QS_4, QS_5, QS_6

(demand price) PD_1^{US}, PD_2^{US}, PD_3^{US}, PD_4^{US}, PD_5^{US}, PD_6^{US},
PD_1^{EC}, PD_2^{EC}, PD_3^{EC}, PD_4^{EC}, PD_5^{EC}, PD_6^{EC},

(supply price) PS_1, PS_2, PS_3, PS_4, PS_5, PS_6,

(quota markup) m^{US}, m^{EC}.

Note that QD_3^{US}, QD_4^{US}, QD_3^{EC}, and QD_5^{EC} are exogenously given by the amount of the binding MFA quotas. Further note that, while m's are endogenous variables in the model, they will be treated as exogenous variables in the actual estimation, as mentioned above.

5. Equilibrium after Trade Liberalization

Once we have a basic framework (i.e. equilibrium conditions in the current situation where the MFA quotas and tariffs are existent), it is very easy to conduct various analyses based on comparative statics. In this paper, the effects of four hypothetical cases of trade liberalization are empirically analyzed by using the framework presented above.

(Case 1) the Removal of MFA quotas by the U.S. and the EC

In this case, $m^{US} = 0$ and $m^{EC} = 0$ should be added to the above equilibrium conditions.

(Case 2) the Removal of MFA quotas by the U.S. only

In this case, $m^{US} = 0$ should be added to the above equilibrium conditions.

(Case 3) the Removal of MFA quotas by the EC only

In this case, $m^{EC} = 0$ should be added to the above equilibrium conditions.

(Case 4) the Removal of MFA quotas and tariffs by the U.S. and the EC

In this case, $m^{US} = 0$, $m^{EC} = 0$, $t^{US} = 0$, and $t^{EC} = 0$ should be added to the above equilibrium conditions.

Therefore, once the values of all parameters in the model are determined, the estimation of the effects of the trade liberalization (and the effects of trade restrictions like the MFA and tariffs) is surprisingly easy by using the simple model of the paper.

III. DATA AND DETAILED METHOD OF ESTIMATION

As it is clear from the discussion in the previous section, if the values of all coefficients of the equations and other exogenous variables are

determined, it is very easy to solve the model either in the quota equilibrium or non-quota equilibrium. Unfortunately, however, it is extremely difficult to directly obtain the values of these coefficients, and therefore, an indirect method was taken. Namely, the observed values of the quantity (QD's and QS's) and the demand price (PD's) are assumed to be equilibrium values of these endogenous variables generated by the model under the existing MFA quotas and tariffs. PS's are calculated from PD's after discounted by the tariff rate (actual data) and by the quota markup (borrowed from the estimates of Hamilton (1988)). By using these equilibrium values of endogenous variables, coefficients of equations in the model can be indirectly calculated. The detail of the method is discussed below.

1. Country Classification

First of all, we have to classify many supplying countries of clothing into 6 categories (G_1 through G_6 in Figure 1 above). By definition, G_1 and G_2 are the United States and the EC, respectively. Each developing country was classified into one of the remaining four categories (G_3 through G_6), depending on whether it is restricted by the binding quotas in the U.S. market and the EC market. As mentioned earlier, some MFA quotas are not binding while others are strictly binding. Therefore, the fact that LDC A has a bilateral MFA agreement with the United States does not necessarily mean that the country is effectively restricted in the U.S. market. For example, when the utilization of the quota is very low, the quota is often unnecessary and non-binding. And when the bilateral agreement covers very limited items, it would be easy for the exporting country to shift their shipment from restricted items to unrestricted items.

In view of the above, I classified exporting LDCs not according to the mere existence of bilateral quotas but according to the existence of binding bilateral

quotas, taking into account the MFA coverage rate and the quota utilization rate. Table 3 and Table 4 give background data for such classification. The first column of Table 3 lists developing countries which have bilateral MFA quota agreement with the United States in 1986, and the second column of the table shows the value of shipments of clothing to the United States in 1986. The third column shows the "MFA coverage", which is defined as the ratio of shipments of clothing subject to MFA restrictions to total clothing shipments to the United States (in percent). For example, 75 percent of the clothing shipments from Bangladesh was subject to MFA quotas in 1986. Note that, while the MFA coverage is an indicator of the restrictiveness of the MFA quotas against the exporting country, the high value of the MFA coverage does not necessarily mean that the country is severely restricted by the MFA quotas. If the amount of the MFA quota is more than the amount the country can supply, the quota is not binding and often meaningless. The fourth column of the table shows the "utilization rate", which is defined as the ratio of actual shipments to MFA quota amounts. For example, in Table 3, the utilization rate of China is 98.5 percent, and therefore, quotas against Chinese clothing shipments seems strongly binding, while the utilization rate of, say, Maldives is only 1.5 percent and she can increase her shipment drastically under the current quota limitation when other constraints (mostly supply constraints) were removed. The last (fifth) column of the table shows "binding rate", which is defined as the geometric mean of "MFA coverage" and "utilization rate". In order to take into account both the degree of the product coverage of the MFA quotas and the degree of utilization of each quota, I used the "binding rate" as a criterion when developing countries are classified into the above four categories. I used seventy percent as a cut-off point: when the binding rate is more than 70 percent, the country is considered

Table 3: U.S. IMPORTS OF CLOTHING FROM RESTRICTED DEVELOPING COUNTRIES

Country	Value of Shipment ($Million)	MFA Coverage[a] (%)	Utilization Rate[b] (%)	Binding Rate[c] (%)
Bangladesh	173.1	75.0	93.9	83.9
Brazil	101.7	100.0	29.4	54.2
China	1,874.5	78.4	98.5	87.9
Colombia	48.9	99.4	27.9	52.7
Costa Rica	146.6	14.6	67.0	31.3
Dominican Republic	293.6	13.0	39.5	22.7
Egypt	5.5	0.0	0.0	0.0
Guatemala	20.7	0.0	0.0	0.0
Haiti	125.7	41.6	35.6	38.5
Hong Kong	3,660.8	67.0	76.9	71.8
India	393.3	59.5	93.3	74.5
Indonesia	296.8	90.5	90.9	90.7
Korea	2,736.3	61.5	86.4	72.9
Macao	246.7	84.9	67.4	75.6
Malaysia	278.3	81.1	72.9	76.9
Maldives	9.6	1.1	1.5	1.3
Mauritious	96.1	38.2	80.8	55.6
Mexico	321.9	87.4	67.8	77.0
Nepal	34.5	65.7	65.5	65.6
Pakistan	102.0	90.0	89.4	89.7
Panama	29.4	0.0	0.1	0.0
Peru	18.3	0.0	0.0	0.0
Philippines	510.3	76.3	59.2	67.2
Romania	88.4	100.0	60.9	78.0
Singapore	409.7	93.5	74.4	83.4
Sri Lanka	286.4	87.9	80.2	84.0
Taiwan	2,822.6	84.9	84.1	84.5
Thailand	224.6	68.4	83.9	75.8
Turkey	154.5	66.4	69.8	68.1
Uruguay	63.6	12.6	93.9	34.4
Yugoslavia	63.9	59.6	74.3	66.5

a/ The ratio of shipments subject to MFA restrictions to total shipments.
b/ The ratio of actual shipments to MFA quota amounts.
c/ Geometric mean of "MFA coverage" and "utilization rate."

Source: World Bank computer files on MFA and UN Trade Statistics.

Table 4: EC IMPORTS OF CLOTHING FROM RESTRICTED DEVELOPING COUNTRIES

Country	Value of Shipment ($Million)	MFA Coverage[a] (%)	Utilization Rate[b] (%)	Binding Rate[c] (%)
Brazil	45.6	12.5	36.7	21.4
China	577.6	43.0	99.7	65.5
Colombia	4.0	0.0	0.0	0.0
Egypt	16.7	22.2	29.7	25.7
Hong Kong	2,095.2	87.5	75.9	81.5
India	454.3	68.9	58.3	63.4
Indonesia	56.9	50.0	75.4	61.4
Korea	1,187.7	70.1	83.2	76.4
Macao	345.4	85.4	88.0	86.7
Malaysia	99.7	32.6	41.1	36.6
Mexico	5.1	0.0	0.0	0.0
Pakistan	163.5	12.4	90.5	33.5
Peru	3.6	15.6	12.8	14.1
Philippines	146.5	61.8	57.6	59.7
Romania	355.9	61.9	81.2	70.9
Singapore	69.2	74.8	30.7	47.9
Sri Lanka	102.9	43.5	81.6	59.6
Taiwan	501.6	79.4	79.0	79.2
Thailand	251.4	59.9	103.4	78.7
Uruguay	30.9	0.0	0.0	0.0
Yugoslavia	944.5	40.7	110.5	67.1

a/ The ratio of shipments subject to MFA restrictions to total shipments.
b/ The ratio of actual shipments to MFA quota amounts.
c/ Geometric mean of "MFA coverage" and "utilization rate."

Source: World Bank Computer files on MFA and UN Trade Statistics.

to be effectively restricted by the binding quotas of the United States. For example, Bangladesh (its binding rate is 83.9 percent) was effectively restricted by the U.S. while, say, Costa Rica (31.3 percent) was not. Table 4 lists the equivalent data for the EC market.

By using the data on the binding rate in Table 3 and Table 4, the clothing exporting LDCs are classified into 4 groups. The complete listing of the countries is given in Table 5 below.

Table 5: CATEGORIES OF CLOTHING SUPPLIERS

Category 1	(G_1):	United States
Category 2	(G_2):	EC
Category 3	(G_3):	LDCs effectively restricted by both the U.S. and EC (Hong Kong, Korea, Macao, Romania, Taiwan, Thailand)
Category 4	(G_4):	LDCs effectively restricted by the U.S. but not EC (Bangladesh, China, India, Indonesia, Malaysia, Mexico, Pakistan, Singapore, Sri Lanka)
Category 5	(G_5):	LDCs effective restricted by EC but not by the U.S. (None)
Category 6	(G_6):	LDCs effectively restricted by neither the U.S. nor EC (Brazil, Colombia, Costa Rica, Dominican Republic, Egypt, Guatemala, Haiti, Maldives, Mauritius, Nepal, Panama, Peru, Philippines, Turkey, Uruguay, Yugoslavia, other LDCs not listed in this table)

Note: For criteria of the above classification, see main text.

2. Coefficients of Demand Functions

Note that, when own-price elasticities, cross-price elasticities, and observed equilibrium values of QD's and PD's are known, we can obtain values of coefficients of demand functions (a's and b's).

By differentiating the demand function of product i in the U.S. market (i.e. equation (1)) with respect to price of product j, we obtain the following:

$$(17)\quad \frac{\partial QD_i}{\partial PD_j} = a_{i,j}$$

Rearranging equation (17), we get equation (18).

$$(18)\quad a_{ij} = \epsilon_{ij} \frac{QD_i}{PD_j}$$

where ϵ_{ij} is the elasticity of product i with respect to the price of product j, which is defined as follows.

$$(19)\quad \epsilon_{ij} \equiv \frac{\partial QD_i}{\partial PD_j} \cdot \frac{PD_j}{QD_i}$$

By using equation (18), we can obtain a_{ij} ($j \neq 0$). a_{i0} can be obtained by substituting the values of a_{ij} ($j \neq 0$) and values of quantity and price into each demand function. By applying the same technique to demand functions in the EC market (equation (2)), the values of b's are obtained.

In reality, however, individual own-price elasticities and cross-price elasticities are very difficult to obtain, therefore, I used the so-called Armington (1969) technique which we already used elsewhere (see Erzan, Goto, Holmes (1990)). By using the Armington's formulae, we can derive individual elasticities from the aggregate elasticity (η), the value share of each product (S_i), and the elasticity of substitution (σ). By assuming CES functions, Armington derived the following formula.

$$(20)\quad \frac{dX_{ij}}{X_{ij}} = \epsilon_i \frac{dD}{D} - [(1-S_{ij})\ \sigma_i + S_{ij}\ \eta_i] \frac{dP_{ik}}{P_{ik}} + \sum_{k \neq j} [S_{ik}\ \sigma_i - S_{ik}\ \eta_i] \frac{dP_{ik}}{P_{ik}} + \sum_{k \neq i} \eta_{ik} \frac{dP_k}{P_k}$$

From this formulation, it follows:

$$(21)\quad \epsilon_{i,i} = (1-S_i)\,\sigma + S_i\eta$$

$$(22)\quad \epsilon_{i,j} = (S_j\,\sigma - S_j\,\eta)$$

where $\epsilon_{i,i}$ is own price elasticity of product i, and $\epsilon_{i,j}$ is cross price elasticity of product i with respect to the price of product j.

By using the above method, the values of all the coefficients of demand functions (a's and b's) can be obtained from the aggregate demand elasticity (η), the elasticity of substitution among products (σ), the value share of each product (S_i), and the quantity observed and price of each product observed. S_i's were calculated from actual trade data. I used $\eta = 0.282$: Houthakker (1965)'s estimate which is used in the studies by Tarr-Morkre (1984) and by Erzan, Goto, Holmes (1990). I set $\sigma = 3$, which is the same as our above-mentioned previous study (σ=3).

Of course, the reasonable value of σ is very difficult to determine. Although I used 3.0 here, other studies used different values. For example, in the above-mentioned study by Trela and Whalley much higher value ($\sigma = 5.0$) was used while Suphachalasai (1989) used very low value ($\sigma = 1.0$). None of these values was obtained from a rigorous estimation. In view of this, I made a sensitivity analysis, which is reported later in the paper. As will become clearer, the results based on the model in this paper are surprisingly stable (i.e. insensitive to the value of σ).

From the above data, all of the coefficients of demand functions were calculated.

3. Coefficients of Supply Functions

The coefficients of supply functions can be obtained much more easily than those of demand functions. The coefficients (c_i and d_i in equation (3)) can be obtained when supply elasticities and observed equilibrium values of QS_i and PS_i are obtained. First of all, QS_i is just summation of QD_i^{US} and QD_i^{EC}. PS_i can be calculated from values of PD_i, t^{US}, t^{EC}, m^{US}, and m^{EC}. For the tariff rate I used the actual data, and set t^{US} and t^{EC} as 0.207 (20.7 percent) and 0.134 (13.4 percent), respectively. For the quota markup rate, I used Hamilton (1988)'s estimate, and set m^{US} and m^{EC} as 0.195 and 0.107, respectively. Once PS_i is calculated by these data, coefficients of supply functions (c_i and d_i) can be obtained as soon as the elasticity of supply is specified.

By differentiating the supply functions of product i (i.e., equation (3)) with respect to the supply price of the product (PS_i), we obtain the following.

$$(23) \quad \frac{\partial QS_i}{\partial PS_i} = d_i$$

Rearranging equation (23), we get equation (24).

$$(24) \quad d_i = e_i \frac{QS_i}{PS_i}$$

where e_i is the elasticity of supply of product i (or country group i), which is defined as follows.

$$(25) \quad e_i \equiv \frac{\partial QS_i}{\partial PS_i} \cdot \frac{PS_i}{QS_i}$$

By using equation (24) we can obtain the values of d's. c's can be obtained by substituting the values of d's and vaules of quantity and price into each supply function. For the value of supply elasticities I used 2 here. The result of

the main estimate using the parameter values reported above are presented in the next section. But, it seems extremely difficult to get reliable estimate of the values of supply elasticities, as well as elasticity of substitution, therefore, for the purpose of sensitivity analysis, I reported the comparable results when all supply elasticities are set to infinity.

IV. RESULTS OF ESTIMATION[1]

The general equilibrium trade model discussed above has been used to analyze the effects of various scenarios of liberalization of the clothing trade. As shown below, by using the data in 1986, the estimation (simulation) was made for the following four scenarios: (i) simultaneous removal of the MFA quotas by the U.S. and EC; (ii) unilateral removal of the MFA quotas by the U.S.; (iii) unilateral removal of the MFA quotas by the EC; and (iv) simultaneous removal of the MFA quotas and tariffs by the U.S. and EC. For each set of estimation, the effect on each group of exporting LDCs as well as domestic producers in the developed country are reported. At the end of this section, the long run effect derived by the model assuming infinite supply elasticities is also reported.

1. Simultaneous Removal of the MFA Quota

As shown above, many countries have been restricted by the binding MFA quotas. According to Hamilton (1988), due to the MFA quotas, the domestic price of clothing in the U.S. (in the EC) is 19.5% (10.7%) higher than otherwise. Table 6 is a summary of results of our estimation on the change in clothing trade.

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[1] The magnitude of our results of change in trade is generally smaller than the result by Trela and Whalley (1988). There are several sources for the difference, including: (i) the simplification adopted by Trela and Whalley that all quotas were binding; (ii) the parameter value used for the import demand elasticity (0.28 in the present paper versus 0.6); (iii) the parameter value used for the elasticity of substitution (3.0 here versus 5.0).

Table 6: EFFECTS OF LIBERALIZATION OF CLOTHING TRADE

Case 1: Simultaneous Removal of Quotas by the U.S. and the EC

Suppliers	Current Value of Shipment ($ Million)	Value Change ($ Million)	Value Change (%)	Quantity Change (%)
U.S. MARKET				
G_1	53,172.3	-3,325.9	-6.3	-4.2
G_2	1,640.0	-196.0	-12.0	-11.7
G_3	9,779.6	728.0	7.4	19.3
G_4	4,135.9	408.0	9.9	24.3
G_6	2,331.0	-210.0	-9.0	-8.3
(Total Imports)	17,886.6	730.2	4.1	16.5
EC MARKET				
G_1	149.0	4.3	2.9	5.1
G_2	39,706.1	-216.6	-0.5	-0.2
G_3	4,737.2	199.1	4.2	7.2
G_4	1,549.4	-208.3	-13.4	-18.0
G_6	6,272.1	16.7	0.3	1.0
(Total Imports)	12,707.7	11.9	0.1	0.1
TOTAL				
G_1	53,321.3	-3,321.6	-6.2	-4.2
G_2	41,346.1	-412.6	-1.0	-0.7
G_3	14,516.9	927.3	6.4	15.2
G_4	5,685.3	199.8	3.5	11.2
G_6	8,603.1	-193.3	-2.2	1.5

Note: G_1 - U.S.A.
G_2 - EC10.
G_3 - LDCs which are restricted by binding quotas of US and EC.
G_4 - LDCs which are restricted by binding quotas of US alone.
G_6 - LDCs which are not restricted by binding quota.

if all existing MFA quotas were removed. Note that, as observed in the previous section, in 1986 there are no developing countries which are restricted by the binding quotas of the EC but not by the U.S. (G_5), so G_5 is omitted in the tables in this section.

First of all, it should be noted that due to the MFA the shipments from G_3 countries (LDCs which are restricted by the binding quotas of the U.S. and EC) are severely restricted. According to our estimation, if all the MFA quotas were removed the value of their shipments would increase by almost one billion dollars while shipments of the U.S. and EC would decline by $3.3 billion and $0.4 billion, respectively. The increase of shipments from G_3 countries is more significant in the U.S. market than in the EC market, because as Hamilton's estimate suggests, the restrictiveness in the U.S. market is stronger than that in the EC in the 1980s.

Secondly, our estimation result suggests that so-called "spillover" effect of the MFA is not so large as sometimes alleged. As summarized by Goto (1989) in detail, because of the discriminatory nature of MFA quotas, which are different from global quotas permitted under GATT article 19, some unrestricted developing countries benefit from the MFA. It is often alleged that the magnitude of the spillover effect is large. For example, Keesing and Wolf (1980) presented data from the late 1950s and 1960s as evidence of the spillover: Immediately after Japan announced a VER on shipments to the United States, Hong Kong dramatically increased shipments to fill the gap. But, our estimate for the year 1986 suggests that the magnitude of the spillover effect is not as large as often alleged. As Table 6 shows, due to the MFA quotas on other developing countries, the value of apparel shipments from unrestricted developing countries

(G_6 countries) in the U.S. market is larger by only $200 million (9 percent). When the two markets are taken together, the so-called spillover effect to unrestricted suppliers is just a little more than 2 percent of their shipment.

2. Unilateral Removal of the MFA Quotas

What would happen if MFA quotas of only one market (either the U.S. or EC) were removed? It is expected that if only one market is restricted, the increase in imports in the unrestricted market is bigger than in the case of unilateral liberalization. It is sometimes argued that during the period under MFA I (January 1974-December 1977), the EC's imports of textiles and clothing dramatically increased because exports of these products from developing countries shifted to the EC market from the United States, where a comprehensive system of bilateral restrictions had been set up in 1971.

It is estimated, however, that the increase in imports of clothing is not as dramatic as often alleged, even if MFA quotas were removed only in one of the two markets. Table 7 is a summary of estimation when only the United States abolished the MFA quotas, while Table 8 is a summary of estimation when only the EC abolished the MFA quotas.

As Table 7 shows, when only the United States removed its MFA quotas, the increase in the value of U.S. clothing imports would be 0.76 billion dollars, which is not very different from the increase when simultaneous quota removal were realized. On the other hand, the unilateral quota removal by the EC would have a little stronger impact on the EC clothing imports than the simultaneous quota removal (see Table 3). But, even in this case, the increase in the value of clothing imports by the EC would be only 0.3 billion dollars.

Table 7: EFFECTS OF LIBERALIZATION OF CLOTHING TRADE

Case 2: Unilateral Removal of Quotas by the U.S.

Suppliers	Current Value of Shipment ($ Million)	Value Change ($ Million)	Value Change (%)	Quantity Change (%)
U.S. MARKET				
G_1	53,172.3	-3,656.7	-6.9	-4.7
G_2	1,640.0	-242.5	-14.8	-15.1
G_3	9,779.6	892.7	9.1	23.7
G_4	4,135.9	364.5	8.8	23.0
G_6	2,331.0	-259.2	-11.1	-10.9
(Total Imports)	17,886.6	755.6	4.2	18.1
EC MARKET				
G_1	149.0	10.5	7.1	9.6
G_2	39,706.1	742.1	1.9	1.5
G_3	4,737.2	-424.1	-9.0	-13.6
G_4	1,549.4	-148.4	-9.6	-14.5
G_6	6,272.1	196.1	3.1	3.4
(Total Imports)	12,707.7	-365.8	-2.9	-6.6
TOTAL				
G_1	53,321.3	-3,646.2	-6.8	-4.6
G_2	41,346.1	499.6	1.2	0.8
G_3	14,516.9	468.6	3.2	10.9
G_4	5,685.3	216.1	3.8	11.4
G_6	8,603.1	-63.1	-0.7	-0.5

Note: G_1 - U.S.A.
G_2 - EC10.
G_3 - LDCs which are restricted by binding quotas of U.S. and EC.
G_4 - LDCs which are restricted by binding quotas of US alone.
G_6 - LDCs which are not restricted by binding quota.

Table 8: EFFECTS OF LIBERALIZATION OF CLOTHING TRADE

Case 3: Unilateral Removal of Quotas by the EC

Suppliers	Current Value of Shipment ($ Million)	Value Change ($ Million)	Value Change (%)	Quantity Change (%)
U.S. MARKET				
G_1	53,172.3	374.3	0.7	0.5
G_2	1,640.0	45.3	2.8	3.5
G_3	9,779.6	-272.5	-2.8	-4.6
G_4	4,135.9	53.7	1.3	1.4
G_6	2,331.0	48.8	2.1	2.6
(Total Imports)	17,886.6	-124.7	-0.7	-1.7
EC MARKET				
G_1	149.0	-6.2	-4.2	-4.4
G_2	39,706.1	-912.8	-2.3	-1.6
G_3	4,737.2	499.6	10.5	20.1
G_4	1,549.4	-55.3	-3.6	-3.5
G_6	6,272.1	-172.7	-2.8	-2.3
(Total Imports)	12,707.7	265.3	2.1	6.4
TOTAL				
G_1	53,321.3	368.1	0.7	0.5
G_2	41,346.1	-867.5	-2.1	-1.4
G_3	14,516.9	227.1	1.6	3.9
G_4	5,685.3	-1.7	-0.0	-0.1
G_6	8,603.1	-123.9	-1.4	-1.0

Note: G_1 - U.S.A.
G_2 - EC10.
G_3 - LDCs which are restricted by binding quotas of U.S. and EC.
G_4 - LDCs which are restricted by binding quotas of US alone.
G_6 - LDCs which are not restricted by binding quota.

3. Removal of Quotas and Tariffs

As noted earlier, clothing trade is restricted not only by the MFA quotas but also by high tariffs. As summarized in Goto (1989), the tariff rate on textiles and clothing after the Tokyo round of GATT negotiations is almost three times higher than that on manufactured goods as a whole. Moreover, during the Tokyo round, tariff rates on textile and clothing were not reduced as much as the rates on manufactured products. In the 1980s, the average tariff rates on clothing in the U.S. and EC are 20.7 percent and 13.4 percent, respectively.

Table 9 shows a summary of our estimate of change in clothing trade when existing quotas and tariffs were removed. Because of the high tariffs at present, the magnitude of the change is large. Especially, the effect of such liberalization on the U.S. producers is impressive. As Table 9 shows, when all the tariffs and quotas were removed, the value of clothing shipments by the U.S. producers would decrease by almost 8 billion dollars (or 14.4%).

In other word, the U.S. producers are heavily protected by various trade restrictions. Since most of clothing is imported from the developing countries, if such a comprehensive trade liberalization were realized, the magnitude of the gains by the LDCs is very large. When the two markets are taken together, the LDCs could increase their clothing shipments by as much as $7.2 billion.

4. Sensitivity Analysis

(a) Supply elasticity

As mentioned in Section III, in the above estimations I used 2.0 for the value of supply elasticities. But, in the long run, the value of supply elasticities would be much higher than 2.0 because over time various adjustments, including foreign direct investment, are possible. In view of this, I have made calculations using extreme value (infinity) for supply elasticities. Table 10 gives the comparable results when all supply elasticities are set to infinity.

Table 9: EFFECTS OF LIBERALIZATION OF CLOTHING TRADE

Case 4: Simultaneous Removal of Quotas and Tariffs by the U.S. and EC

Suppliers	Current Value of Shipment ($ Million)	Value Change ($ Million)	Value Change (%)	Quantity Change (%)
U.S. MARKET				
G_1	53,172.3	-7,636.1	-14.4	-10.0
G_2	1,640.0	383.7	23.4	24.9
G_3	9,779.6	3,035.8	31.0	36.2
G_4	4,135.9	1,351.9	32.7	40.3
G_6	2,331.0	430.8	18.5	11.7
(Total Imports)	17,886.6	5,202.3	29.1	34.3
EC MARKET				
G_1	149.0	51.2	34.3	41.3
G_2	39,706.1	-1,865.6	-4.7	-3.5
G_3	4,737.2	1,072.4	22.6	18.1
G_4	1,549.4	95.1	6.1	-6.1
G_6	6,272.1	1,195.2	19.1	12.3
(Total Imports)	12,707.7	2,413.9	19.0	11.7
TOTAL				
G_1	53,321.3	-7,584.9	-14.2	-9.8
G_2	41,346.1	-1,481.8	-3.6	-2.4
G_3	14,516.9	4,108.2	28.3	30.0
G_4	5,685.3	1,447.0	25.5	26.0
G_6	8,603.1	1,626.0	18.9	12.1

Note: G_1 - U.S.A.
G_2 - EC10.
G_3 - LDCs which are restricted by binding quotas of U.S. and EC.
G_4 - LDCs which are restricted by binding quotas of US alone.
G_6 - LDCs which are not restricted by binding quota.

Table 10: LONG-RUN EFFECTS OF LIBERALIZATION OFCLOTHING TRADE

(Infinite Supply Elasticity Case)

Suppliers	Current Value of Shipment ($M)	Removal of Quotas			Removal of Quotas and Tariffs		
		Value Change ($M)	Value Change (%)	Quantity (%)	Value Change ($M)	Value Change (%)	Quantity (%)
U.S. MARKET							
G_1	53,172.3	-5,287.5	-9.9	-9.9	-11,528.6	-21.7	-21.7
G_2	1,640.0	-163.6	-10.0	-10.0	487.2	29.7	29.7
G_3	9,779.6	1,591.5	16.3	38.9	4,153.4	42.5	70.1
G_4	4,135.9	673.4	16.3	38.9	1,756.9	42.5	70.2
G_6	2,331.0	-232.3	-10.0	-10.0	691.7	29.7	29.7
(Total Imports)	17,886.6	1,869.0	10.4	31.6	7,089.2	39.6	64.1
EC MARKET							
G_1	149.0	-3.9	-2.6	-2.6	36.7	24.6	24.7
G_2	39,706.1	-1,031.9	-2.6	-2.6	-4,298.5	-10.8	-10.8
G_3	4,737.2	669.4	14.1	26.3	1,686.8	35.6	50.0
G_4	1,549.4	-41.2	-2.7	-2.7	380.1	24.5	24.5
G_6	6,272.1	-163.3	-2.6	-2.6	1,540.1	24.6	24.5
(Total Imports)	12,707.7	461.1	3.6	9.0	3,643.8	28.7	34.7
TOTAL:							
G_1	53,321.3	-5,291.4	-9.9	-9.9	-11,491.9	-21.6	-21.5
G_2	41,346.1	-1,195.5	-2.9	-2.9	-3,811.3	-9.2	-9.2
G_3	14,516.9	2,260.9	15.6	34.6	5,840.2	40.2	63.2
G_4	5,685.3	632.2	11.1	26.1	2,137.0	37.6	56.0
G_6	8,603.1	-395.6	-4.6	-4.6	2,231.8	25.9	25.9

Note
G_1 - U.S.A
G_2 - EC10.
G_3 - LDCs which are restricted by binding quotas of U.S. and EC.
G_4 - LDCs which are restricted by binding quotas of US alone.
G_6 - LDCs which are not restricted by binding quota.

As this table shows, the magnitude of the long run effects is much larger than the above (short-run) estimates. For example, when simultaneous quota removal by the U.S. and EC were realized, the value of imports in the U.S. and in the EC would increase almost $2 billion and $500 million, respectively. If all the quotas and tariffs were removed, the value of clothing exports from LDC would

increase by $10 billion (or by 35.4 percent). On the other hand, the shipments by the domestic producers in the U.S. and EC would dramatically decrease.

(b) Elasticity of Substitution (σ)

In addition to the supply elasticity, the value of the elasticity of substitution among differentiated products is also controversial. As pointed out earlier, the elasticity values used in the previous studies vary very much. For example, Trela and Whalley (1988) used very high value (5.0), but they did not provide sensitivity analysis. On the other hand, Suphachalasai (1988) used very low value (1.0). He also reported the estimation results based on the high value used by Trela and Whalley, and he admitted that the results based on his model varied widely depending on the values of elasticity of substitution.

In view of the fact that there has been no reliable estimate of the elasticity of substitution among clothing products from different countries, I also conducted a sensitivity analysis on it. The result of the sensitivity analysis is given in Table 11 below. In the table, three sets of estimations of the effects of simultaneous removal of the MFA quota are reported. As this table shows, on average, the results obtained from the model in this paper is fairly stable (i.e., they do not fluctuate widely depending on the values of elasticity of substitution). For example, the so-called spillover effect for unrestricted LDCs (G_6) is less than 3 percent even if I used very high value of σ (5.0).

V. CONCLUDING REMARKS

In this paper, I have developed a simple general equilibrium trade model for the analysis of the MFA, which consists of two markets (the U.S. and the EC) and 6 groups of supplying countries. Although the structure of the model is very

Table 11: EFFECTS OF SIMULTANEOUS REMOVAL OF QUOTAS BY THE U.S. AND THE EC

(A Sensitivity Analysis)

Suppliers	Current Value of Shipment ($M)	Value Change ($ M)			Value Change (%)		
		σ=2	σ=3	σ=5	σ=2	σ=3	σ=5
U.S. MARKET							
G_1	53,172.3	-2,531.6	-3,325.9	-4,349.4	-4.8	-6.3	- 8.2
G_2	1,640.0	-119.2	-196.0	-364.1	-7.3	-12.0	-22.2
G_3	9,779.6	281.5	728.0	1,318.4	2.9	7.4	13.5
G_4	4,135.9	152.4	408.0	828.6	3.7	9.9	20.0
G_6	2,331.0	-135.0	-210.0	-365.2	-5.8	-9.0	-15.7
(Total imports)	17,886.6	179.7	730.2	1,417.8	1.0	4.1	7.9
EC MARKET							
G_1	149.0	0.9	4.3	13.8	0.6	2.9	9.3
G_2	39,706.1	-250.8	-216.6	-44.3	-0.6	-0.5	-0.1
G_3	4,737.2	129.7	199.1	211.7	2.7	4.2	4.5
G_4	1,549.4	-95.2	-208.3	-466.9	-6.1	-13.4	-30.1
G_6	6,272.1	-21.3	16.7	133.6	-0.3	0.3	2.1
(Total Imports)	12,707.7	14.2	11.9	-107.8	0.1	0.1	-0.8
TOTAL							
G_1	53,321.3	-2,530.7	-3,321.6	-4,335.5	-4.7	-6.2	-8.1
G_2	41,346.1	-370.0	-412.6	-408.4	-0.9	-1.0	-1.0
G_3	14,516.9	411.2	927.3	1,530.2	2.8	6.4	10.5
G_4	5,685.3	57.1	199.8	361.7	1.0	3.5	6.4
G_6	8,603.1	-156.2	-193.3	-231.6	-1.8	-2.2	-2.7

simple, it is powerful for the analysis of various effects of the MFA, including trade suppressing effect, trade diversion effect among markets, and so-called spillover effect.

After developing the model, the model has been applied to the clothing trade in 1986. Clothing suppliers are classified into 6 groups: (i) the U.S.; (ii) the EC; (iii) LDCs restricted by the binding quotas of the U.S. and EC; (iv) LDCs restricted by the binding quotas of the U.S. but not by the EC; (v) LDCs restricted by the binding quotas of the EC but not by the U.S.; (vi) unrestricted LDCs. By using the model, various scenarios of liberalization of clothing trade have been analyzed: (i) simultaneous removal of MFA quotas; (ii) unilateral removal of MFA quotas by either the U.S. on EC; (iii) simultaneous removal of MFA quotas and tariffs.

Estimation (simulation) results suggest that the major beneficiary of the MFA is the domestic producer in the importing developed countries. Due to the MFA the value of shipments of clothing by the U.S. producers is more than $3 billion higher ($400 million for the EC producers) than otherwise. When MFA quotas and tariffs are taken together, the value of clothing shipments by the U.S. producers is $8 billion higher ($1.5 billion for the EC producers) than under no such restrictions.

Different from the spillover to domestic producers in developed countries, the spillover to unrestricted developing countries is much smaller than often alleged. It is estimated that such spillover effect of the MFA to unrestricted LDCs is less than $200 million (or 2.2 percent of the value of shipment by the unrestricted LDCs). On the other hand the magnitude of trade suppressing effect on the restricted LDCs (such as Hong Kong and Korea) is much larger than that of spillover. Due to the MFA, the value of the clothing exports from restricted LDCs is suppressed by more than $1 billion even in the short run. In the long

run, when all the adjustments are made (i.e. infinite supply elasticities), the value of the lost shipment of the restricted LDCs due to the MFA is more than $2 billion.

Needless to say, as most other estimates, the results of the estimates in this paper depend very much on the chosen values of parameters such as supply elasticities and elasticity of substitution among differentiated products. But, as Table 10 and Table 11 show, main themes of the results remain even when we pick up extreme value of the parameters.

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